

## CLAIMS

### WHAT IS CLAIMED IS:

1. A method of copying data, comprising operations of:
  - receiving a request to copy a body of source data to specified target storage;
  - reviewing contents of the source data to identify data objects therein;
  - for each identified data object, performing copy operations comprising:
    - consulting prescribed metadata records to determine whether a copy of the identified data object already exists in the target storage;
    - only if a copy does not already exist, performing operations comprising:
      - applying prescribed criteria to determine whether the identified data object qualifies for copying;
      - forming a copy of the identified data object in target storage, comprising:
        - if the data object qualifies for copying, writing the data object to the target storage;
        - if the data object does not qualify for copying, instead of writing the data object writing a predetermined bit pattern to the specified target storage;
  - responsive to completion of the forming operation, updating the metadata records to indicate that the data object exists in the specified target storage regardless of whether the data object

20 was replaced with a predetermined bit pattern rather than being  
21 physically written to the specified target storage.

1 2. The method of claim 1,  
2 the reviewing operation comprising reviewing contents of the source data to identify  
3 individual data objects therein, and also reviewing any aggregate data objects  
4 in the source data to identify all constituent data objects thereof;  
5 where the applying and forming operations are performed separately for each data  
6 object whether in individual or aggregated form;  
7 where the operation of updating the metadata records comprises,  
8 for each data object comprising an individual data object, preparing a record  
9 indicating that the data object exists in the specified target storage  
10 regardless of whether the data object was replaced with the  
11 predetermined bit pattern rather than being written to the specified  
12 target storage;  
13 for each data object comprising an aggregated data object, preparing a record  
14 indicating that the data object exists in the specified target storage  
15 regardless of whether any constituent data objects were replaced with  
16 the predetermined bit pattern rather than being written to the specified  
17 target storage.

1 3. The method of claim 2, for each data object comprising an aggregated data object,  
2 further comprising one of the following operations:

forming a record indicating whether the aggregated data object contains any constituent user files replaced with the predetermined bit pattern;  
forming a record specifically identifying any constituent user files replaced with the predetermined bit pattern.

4. The method of claim 2, further responsive to completion of the forming operation, performing operations comprising preparing a metadata record to identify each individual data object that was replaced with a predetermined bit pattern rather than being written to target storage.

5. The method of claim 2, the operations further comprising:  
receiving a request to restore one or more specified data objects from the target storage to a specified restore site;  
for each specified data object, performing restore operations comprising:  
consulting the metadata records to identify one or more copies of the specified data object in the target storage;  
if the specified data object is an individual data object, searching the metadata records to locate a copy in which the data object was not replaced with the predetermined bit pattern;  
if the specified data object is an aggregate data object, searching the metadata records to locate copies of the constituent data objects in which the constituent data objects were not replaced with the predetermined bit pattern;

14 copying each copy located by the search to a specified restore site.

1 6. The method of claim 1, the applying operation comprising one or more of the  
2 following:

3 consulting a previously prepared record designating data objects as qualifying or not;  
4 applying prescribed criteria to characteristics of the data object to determine whether  
5 the data object qualifies or not.

1 7. The method of claim 1, further comprising reclaiming space in the copy by performing  
2 the reviewing, applying, and forming operations to the copy.

1 8. A signal-bearing medium tangibly embodying a program of machine-readable  
2 instructions executable by a digital processing apparatus to perform operations to copy data,  
3 comprising:

4 receiving a request to copy a body of source data to specified target storage;  
5 reviewing contents of the source data to identify data objects therein;  
6 for each identified data object, performing copy operations comprising:  
7 consulting prescribed metadata records to determine whether a copy of the  
8 identified data object already exists in the target storage;  
9 only if a copy does not already exist, performing operations comprising:  
10 applying prescribed criteria to determine whether the identified data  
11 object qualifies for copying;

12 forming a copy of the identified data object in target storage,  
13 comprising:  
14 if the data object qualifies for copying, writing the data object to  
15 the target storage;  
16 if the data object does not qualify for copying, instead of writing  
17 the data object writing a predetermined bit pattern to the  
18 specified target storage;  
19 responsive to completion of the forming operation, updating the  
20 metadata records to indicate that the data object exists in the  
21 specified target storage regardless of whether the data object  
22 was replaced with a predetermined bit pattern rather than being  
23 physically written to the specified target storage.

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11 predetermined bit pattern rather than being written to the specified  
12 target storage;  
13 for each data object comprising an aggregated data object, preparing a record  
14 indicating that the data object exists in the specified target storage  
15 regardless of whether any constituent data objects were replaced with  
16 the predetermined bit pattern rather than being written to the specified  
17 target storage.

10. The medium of claim of claim 9, the operations further comprising, for each data  
object comprising an aggregated data object, one of the following operations:

forming a record indicating whether the aggregated data object contains any  
constituent user files replaced with the predetermined bit pattern;  
forming a record specifically identifying any constituent user files replaced with the  
predetermined bit pattern.

11. The medium of claim 9, further responsive to completion of the forming operation,  
performing operations comprising preparing a metadata record to identify each individual  
data object that was replaced with a predetermined bit pattern rather than being written to  
target storage.

12. The medium of claim 8, the operations further comprising:  
receiving a request to restore one or more specified data objects from the target  
storage to a specified restore site;

4 for each specified data object, performing restore operations comprising:  
5 consulting the metadata records to identify one or more copies of the specified  
6 data object in the target storage;  
7 if the specified data object is an individual data object, searching the metadata  
8 records to locate a copy in which the data object was not replaced with  
9 the predetermined bit pattern;  
10 if the specified data object is an aggregate data object, searching the  
11 metadata records to locate copies of the constituent data objects in  
12 which the constituent data objects were not replaced with the  
13 predetermined bit pattern;  
14 copying each copy located by the search to a specified restore site.

13. The medium of claim 8, the applying operation comprising one or more of the  
following:

consulting a previously prepared record designating data objects as qualifying or not;  
applying prescribed criteria to characteristics of the data object to determine whether  
the data object qualifies or not.

14. The medium of claim 8, further comprising reclaiming space in the copy by performing  
the reviewing, applying, and forming operations to the copy.

15. A logic circuit of multiple interconnected electrically conductive elements configured  
to perform operations to copy data comprising:

3 receiving a request to copy a body of source data to specified target storage;  
4 reviewing contents of the source data to identify data objects therein;  
5 for each identified data object, performing copy operations comprising:  
6 consulting prescribed metadata records to determine whether a copy of the  
7 identified data object already exists in the target storage;  
8 only if a copy does not already exist, performing operations comprising:  
9 applying prescribed criteria to determine whether the identified data  
10 object qualifies for copying;  
11 forming a copy of the identified data object in target storage,  
12 comprising:  
13 if the data object qualifies for copying, writing the data object to  
14 the target storage;  
15 if the data object does not qualify for copying, instead of writing  
16 the data object writing a predetermined bit pattern to the  
17 specified target storage;  
18 responsive to completion of the forming operation, updating the  
19 metadata records to indicate that the data object exists in the  
20 specified target storage regardless of whether the data object  
21 was replaced with a predetermined bit pattern rather than being  
22 physically written to the specified target storage.

- 1 16. A data storage system, comprising:  
2 digital data storage including a body of source data;

3 metadata;

4 a storage director, programmed to perform copy operations comprising:

5 receiving a request to copy a body of source data to specified target storage

6 of the digital data storage;

7 reviewing contents of the source data to identify data objects therein;

8 for each identified data object, performing copy operations comprising:

9 consulting the metadata to determine whether a copy of the identified

10 data object already exists in the target storage;

11 only if a copy does not already exist, performing operations comprising:

12 applying prescribed criteria to determine whether the identified

13 data object qualifies for copying;

14 forming a copy of the identified data object in target storage,

15 comprising:

16 if the data object qualifies for copying, writing the data

17 object to the target storage;

18 if the data object does not qualify for copying, instead of

19 writing the data object writing a predetermined bit

20 pattern to the specified target storage;

21 responsive to completion of the forming operation, updating the

22 metadata to indicate that the data object exists in the

23 specified target storage regardless of whether the data

24 object was replaced with a predetermined bit pattern

25 rather than being physically written to the specified target  
26 storage.

1 17. A data storage system, comprising:  
2 first means for storing digital data including a body of source data;  
3 second means for storing metadata;  
4 third means for copying data of the digital data storage by:  
5 receiving a request to copy a body of source data to specified target storage  
6 in the first means;  
7 reviewing contents of the source data to identify data objects therein;  
8 for each identified data object, performing copy operations comprising:  
9 consulting the second means to determine whether a copy of the  
10 identified data object already exists in the target storage;  
11 only if a copy does not already exist, performing operations comprising:  
12 applying prescribed criteria to determine whether the identified  
13 data object qualifies for copying;  
14 forming a copy of the identified data object in target storage,  
15 comprising:  
16 if the data object qualifies for copying, writing the data  
17 object to target storage;  
18 if the data object does not qualify for copying, instead of  
19 writing the data object writing a predetermined bit  
20 pattern to the specified target storage;

21 responsive to completion of the forming operation, updating the  
22 second means to indicate that the data object exists in  
23 the specified target storage regardless of whether the  
24 data object was replaced with a predetermined bit pattern  
25 rather than being physically written to the specified target  
26 storage.

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